TP 7130 E

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TRANSPORTATION TECHNOLOGY LIMITED

PREPARED FOR: TRANSPORT CANADA, TRANSPORTATION DEVELOPMENT CENTRE

D.S.S. CONTRACT SERIAL NO: 05085-00086

TTL REPORT NO: 338-991-001

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REPORT DOCUMENTATION FORM

1. Transport Canada Report No.	2. TDC Project No.	3. Recipient's Catalogue No.
TP 7130E	6519	

4. Title and Subtitle	5. Report Date
Plan for Testing of the WCSS Railbus on the Inco Railway Line	October 1985
	6. Performing Organization Report No. 339-991-001
7. Author(s) J.H. Stannard, H.R. Skoblenick	8. Transport Canada File No. D1465-425-6
9. Performing Organization Name and Address Transportation Technology Limited P.O. Box 160, Station "A" Kingston, Ontario K7M 1R1	10. DSS File No. 11Sd-T8200-5-5526 11. DSS or Transport Canada Contract No. OSD85-00086
12. Sponsoring Agency Name and Address Transportation Development Centre (TDC) 200 Dorchester Blvd., West Suite 601, West Tower Montreal, Quebec H2Z 1X4	13. Type of Report and Period Covered 14. Sponsoring Agency Code
15. Supplementary Notes	16. TDC Project Officer Sesto Vespa

17. Abstract

The project objective was to plan for the operational testing of the Winnipeg Coach Sales and Service Ltd. (WCSS) Railbus on the Inco Pipe Mine railway line in Thompson, Manitoba. Access to the Inco facility, including use of its track, maintenance facilities and repair shop, was arranged. Arrangements were also made for driver training and for insurance and liability coverage for the test personnel and vehicle operation. The work plan was designed to result in the accumulation of 3000 km of railbus operation. Tests to assess vehicle performance on tangent and curved track sections were planned. A detailed test plan was prepared which included consideration of test speeds, track requirements, and instrumentation. These tests were designed to qualify the vehicle for acceptance by Canadian National Railways (CN) and the Canadian Transport Commission (CTC). CN and CTC engineering and operational requirements were reviewed and the means by which these requirements could be met were analysed and documented. The report concludes with a preliminary plan for operation on the CN line between Thompson, Thicket Portage, and Pikwitonei. Recommendations are made for future work.

18. Key Words	19. Distribution Statement
WCSS Railbus, Operational Testing Alternate Technology, Rail Services Remote Communities, Acceptance.	Limited number of copies available from TDC.

20. Security Classification (of this report)	21. Security Classification (of this page)	22. No. of Pages	23. Price
Unclassified	Unclassified	36	

TDC/CDT 79-005

FORMULE DE DOCUMENTATION POUR RAPPORT

1. Nº du rapport Transports Canada	2. Nº de l'étude — CDT	3. Nº de catalogue du destinataire
TP 7130E	6519	

4. Titre et sous-titre	5. Date du rapport
Plan for Testing of the WCSS Railbus on the Inco Railway Line	octobre 1985
	6. Nº du rapport de l'organisme exécutant: 339-991-001
7. Auteur(s): J.H. Stannard, H.R. Skoblenick	8. Nº de dossier Transports Canada: D1465-425-6
9. Nom et adresse de l'organisme exécutant: Transportation Technology Limited, P.O. Box 160, Station "A", Kingston, Ontario K7M 1R1	10. Nº de dossier — ASC: 11SD-T8200-5-5526
	11. Nº de contrat — ASC ou Transports Canada: OSD85-00086
12. Nom et adresse de l'organisme parrain: Centre de développement des transports (CDT), 200 ouest, boul. Dorchester, Suite 601, tour ouest, Montréal, Québec H2Z 1X4	13. Genre de rapport et période visée
	14. Code de l'organisme parrain
15. Remarques additionnelles	16. Agent de projet — CDT: Sesto Vespa

17. Résumé

Ce rapport rend compte de l'étude planifiant l'essai en service du railbus réalisé par la Winnipeg Coach Sales and Services Ltd. (WCSS), sur le tronçon de chemin de fer appartenant à la Inco Pipe Mine, au départ de Thompson (Manitoba). Une entente a été conclue avec cette compagnie concernant la mise à disposition de ce tronçon et de ses services d'entretien et de réparation. Des dispositions ont aussi été prises relativement à la formation du conducteur et en ce qui concerne l'assurance et l'assurance de responsabilité civile relatives au personnel et au matériel. Un plan de travail a été élaboré visant à parcourir 3 000 km et des essais ont été prévus pour évaluer les performances du véhicule en alignement et en courbe. Un programme d'essais détaillé a été mis au point, prenant en compte les vitesses à soutenir, la qualité de la voie et l'instrumentation à prévoir, programme destiné à obtenir la qualification du CN et de la Commission canadienne des transports. A cette fin, les exigences techniques et opérationnelles formulées par ces deux entités ont été prises en compte et les moyens de les satisfaire analysés et consignés. Le rapport propose un plan préliminaire concernant la desserte de Thompson, Thicket Portage et Pikwitonei par railbus. Il formule également des recommendations quant aux travaux à venir.

18. Mots-clés	19. Diffusion
Railbus WCSS, essai en service, transport de substitution, services ferroviaires aux régions reculées, qualification.	Le CDT dispose d'un nombre limité d'exemplaires.

20. Classification de sécurité (de ce rapport)	21. Classification de sécurité (de cette page)	22. Nombre de pages	23. Prix
non classifié	non classifiée	36	

ACKNOWLEDGEMENT

This planning stage of the program to test the WCSS railbus on the INCO railway line has been carried out under a contract approved by the Department of Supply and Services on behalf of the Transportation Development Centre. The help of Transport Canada Staff and representatives of Canadian National Railways, VIA Rail, International Nickel Company (Thompson), The Canadian Transportation Commission, The Manitoba Department of Highways and Transportation, The Northern Manitoba Regional Government and Thompson Municipal Government are gratefully acknowledged.

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1.0 INTRODUCTION

1.1 BACKGROUND

A Western Flyer bus owned by Transport Canada has been converted for operation on railway tracks by Winnipeg Coach Sales and Service (WCSS) Ltd. This vehicle (Figure 1) is intended to serve as a test vehicle for resolution of institutional and regulatory issues, evaluation of related engineering design concepts and assessment of the overall feasibility of railbus operations in northern remote communities. A demonstration passenger service is planned for northern Manitoba in November 1985, linking Thicket Portage and Pikwitonei with the City of Thompson.

Preliminary operational tests have been conducted by WCSS on the tracks of the Greater Winnipeg Water District Railway in Winnipeg, Manitoba. For the next stage of development testing, the railbus will undergo a series of intensive operational trials on railway lines owned by INCO Limited located in Thompson, Manitoba. The performance and reliability of the vehicle are to be closely monitored during these trials in order to assess its design, and operating characteristics in consideration of the proposed objectives.

The Transportation Development Centre (TDC) has been closely involved with the project since its inception and managed the earlier program during which the vehicle conversion was carried out.

1.2 OBJECTIVES

The overall project objective of TDC is to develop and demonstrate a technology suitable for rail services to remote communities where conventional rail service is extremely costly and alternative modes of transportation are not available.

The specific objective for this initial phase is to prepare a plan for the operation of the WCSS railbus in test service on the INCO Railway Line to:

a) Accumulate 3000 km of operational experience;
b) Gain acceptance by CN Rail and by the Canadian Transportation Commission (CTC) that the railbus vehicle is acceptable for operation in non-passenger carrying service on the Thompson-Pikwitonei-Thicket Portage line of CN Rail; and
c) Establish the maximum safe operating speed on both tangent and curved track.

This plan also introduces the work which will be required to put the bus into actual passenger demonstration/operation. This will be more fully detailed in the final report of the testing phase on the INCO line after operating experience has been gained.

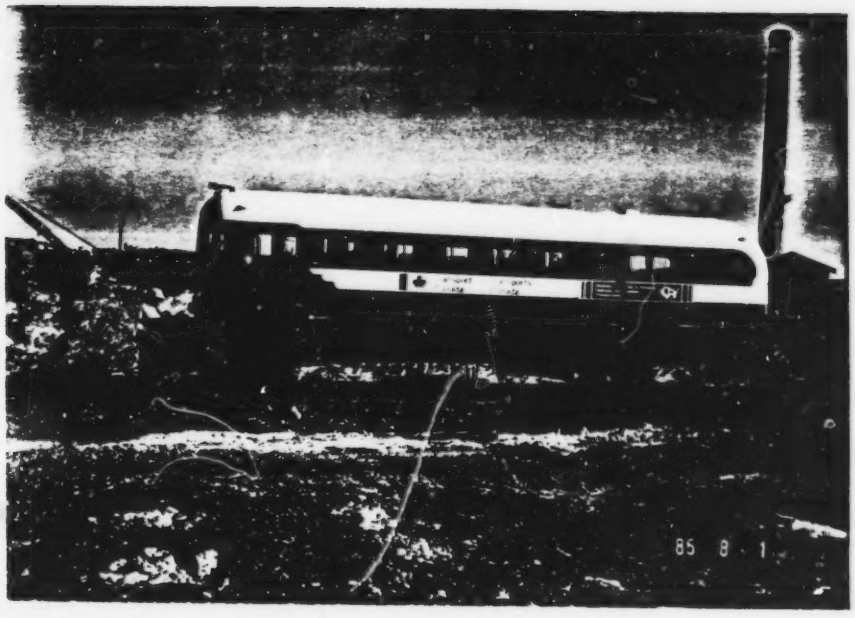

FIGURE 1: THE WINNIPEG COACH SALES AND SERVICE RAILBUS BASED ON A WESTERN FLYER BUS DESIGN

A description of all the work carried out in the planning phase of a two phase program which leads to a subsequent testing phase of the vehicle is included in this final report. All the tasks planned and the overall project methodology are described.

1.3 METHODOLOGY

The design and intended application of the WCSS railbus was reviewed and available documentation summarized to serve as a basis for identification of the operational requirements of the vehicle and subsystem components. The work was largely based on data supplied by the vehicle's manufacturer (WCSS) supplemented by interviews with major operators, equipment suppliers, and an investigatory trip carried out to operate the vehicle (31 July to 01 August 1985).

The railbus and subsystem operational requirements as well as vehicle non-conformances to CTC and CN regulations and standards were defined. Through careful analysis of test results from the testing phase and weighing their impact on rail operations, a list of recommendations and requirements will be formulated to serve as a basis for a passenger railbus service on the specified CN Rail line.

The test vehicle will be examined in various design areas with emphasis on safety and ride quality. Suspension features will be reviewed to identify those factors which may limit the vehicles ability to attain a practical forward speed for the intended service route with the requisite safety and ride quality. The evaluation will be carried out by:

- qualitative and quantitative analysis from test measurements;
- interviews with bus and component manufacturers;
- participation of project consultants (including local community);
- review of relevant data banks;
- engineering analysis; and
- background data review.

The evaluation of the regulations and standards, and CN operational requirements leading to the acceptable operation of the vehicle on the specified rail line was carried out using the following methodology:

- Review of previous correspondences between CN, VIA, CTC and TDC (Transportation Development Center) relative to the technical and regulatory requirements necessary for acceptance of the vehicle for operation on the specified CN Rail line;

- Consultation with CN, VIA and CTC officials;

- Consultation with subcontractors (WCSS and INCO), on site visits and inspection of the WCSS railbus;

- o Identification of the existing Unified Code of Operating Rules (UCOR) and CTC rules and instructions and CNR special instructions contained in their current time table No. 26 which resulted in the determination of areas where the vehicle would not conform to CN or CTC rules and regulations, standard practices and/or design; and

- o Investigation of areas where subsequent request for relief of certain rules may be required and procedures by which relief for the non-conforming items may be obtained.

The above activities in the testing phase will result in a detailed submission to the CTC and CN stating the degree to which the vehicle will meet existing standards. Formal application for exemptions where required and baseline performance measurements for comparison to other passenger rail vehicles will also be submitted. To speed the resolution of institutional issues, the operation on CN lines will be specifically defined with respect to: duration, routing, crewing and testing staff, safety and rescue procedures, operating and testing procedures in view of other traffic which will be running on the specified rail line.

The safe operating procedures necessary for the vehicle will be developed and documented including any required regular inspections and maintenance. This will include plans for vehicle recovery and passenger safety in the event that there is a breakdown, with particular emphasis on winter survival operations. Optional methods for carrying baggage and freight will also be identified.

1.4 ORGANIZATION OF THE REPORT

This report is organized along the lines of the tasks carried out, with Section 2.0 describing the work planning, Section 3.0 the test planning, Section 4.0 the identification of CN and CTC requirements and Section 5.0 the forward planning of operation on the CN main line planned for November of this year. The detailed documentation of the work is included as attachments to the report. Section 6.0 of the report summarizes the Conclusions and Recommendations related to this phase of the project. Included in this final report as Appendix 1 is the Test Plan for the test phase of the work. The test plan is summarized in Section 3.0 of the main body of the report as noted above.

2.0 THE WORK PLAN

2.1 TASKS DURING PLANNING PHASE

The work is described below by task.

2.1.1 Work Plan

A detailed work plan was developed which consists of an activity schedule that indicates the level of work to be accomplished by TTL, and its subcontractors, payment schedule, project management control and documentation procedures.

2.1.2 CTC Requirements

The railbus nonconformances were identified against CTC regulations and standards, (and operational requirements such as UCOR) their impact on rail operations studied and recommendations made for achieving compliance where required (Section 1.0).

2.1.3 CN Requirements

All operator requirements were surveyed and evaluated for operation on the specified CN line. Technical requirements were identified and evaluated towards what can be realistically applicable for an efficient railbus operation. Where required, recommendations were made concerning technical work and test data required from the WCSS testing for CN acceptance on its rail line (Section 4.0).

2.1.4 Test Plan

A test plan was formulated for the operation of the WCSS vehicle on the INCO Rail line. Included was a detailed description of the modifications required, test equipment and necessary data for CN and CTC acceptance of the vehicle on the CN railway line (Section 3.0).

2.1.5 Operating Strategy

A strategy was established for later non-revenue passenger service demonstration operation on the CN railway line (Section 5.0).

2.1.6 Final Report - Planning Phase

To conclude the planning phase a final report summarizing the work carried out in the above tasks and including suggested vehicle modifications necessary for CN and CTC acceptance, as well as details of the test plan and operating strategy while on the INCO Railway Line was prepared.

2.2 TASKS DURING TESTING PHASE

The tasks to be carried out under separate contract during the vehicle operation and testing phases are described below.

2.2.1 Operations Preparation

Initially, INCO would be requested to supply a suitable driver for hire during vehicle testing and mileage accumulation, while TTL personnel will be trained to operate the vehicle on the rail line. It is anticipated that one driver from INCO familiar with local operations and two TTL test personnel will be sufficient for the tests and mileage accumulation.

Access to the INCO railway line will be pre-arranged by agreement with INCO for all test personnel and authorized third parties. Such access for third parties will be monitored and all coordination and supervision on-site carried out by test site personnel. Liability insurance and vehicle insurance will be obtained for the duration of the test period.

Adequate tools, spare parts, equipment and a repair facility will be provided for at the test site in conjunction with INCO shop personnel. Specific test instrumentation and equipment will be shipped from the Kingston test site prior to vehicle preparation.

In addition, when required, miscellaneous test and maintenance equipment will be obtained from local vendors (e.g., Campbell North Tool Rental) or supplied by agreement with INCO Management. Vehicle repair, modification and maintenance will be carried out within the INCO facilities subject to a final agreement with INCO and TTL Project Coordinators.

2.2.2 Vehicle Preparation

The vehicle will be prepared for testing and mileage accumulation. Activities will include:

- thorough vehicle inspection and documentation of critical areas, (especially suspension/body attachment points), via photographic record, physical measurements and review of the construction process (in cooperation with WCSS personnel);
- removal, inspection and repair if required of all wheels and documentation of condition of all wheels;
- inspection of wheel bearings;
- design of drivers safety screen;
- design and installation of engine acoustic treatment;
- replacement of accelerator pedal;
- repositioning of master switch;
- repositioning of rerailing winch, if necessary;
- provision of rerailing hard points on structure;
- installation of test equipment;
- safety check of brakes, axle and frame attachments, etc.;
- installation of classification lights;
- installation of Deadman control;

- o check and calibration of vehicle instrumentation;
- o protection of turntable components against climatic effects;
- o repositioning of pilot to comply with CN regulations;
- o engineering analysis of wheel and bearing expected life;

Work will be carried out by TTL and some tasks subcontracted to INCO and WCSS.

2.2.3 Vehicle Testing

Testing of the vehicle will be carried out in each of the following distinct groups: (To be defined in greater detail in the Test Plan - Section 3.0).

- o Baseline tests of vehicle in current state of modification including:
  - noise;
  - vibration levels (lateral and vertical accelerometers on axles);
  - ride (British Rail Ridemeter method);
  - wheel behaviour (Video monitor);
  - curving behaviour;
  - switching behaviour;
  - fuel consumption; and
  - stability (normal cruise and maximum speed).
- o Mileage accumulation
  - accumulation of approximately 3000 km of operation to establish level of reliability and initial wear rates of bearings and wheels.
- o Vehicle Retest
  - Retest of vehicle after improvements to suspension or design namely ride, comfort, and stability.
- o Rerailing, Turntable and Special Tests

  The operation of the turntable and other special features, including fuel and energy consumptions will be tested. The turntable will be cycled to assess its reliability and long term performance. Centre of gravity and turntable lifting motion will be tested. The vehicle will be deliberately derailed and different rerailing techniques evaluated.
- o Operational Log, Repair and Maintenance

  During all operations a daily record of operation will be kept, supplemented by test reports, photographic and

video record where required. Vehicle repair and maintenance will be carried out as required.

2.2.4 Vehicle Assessment

An engineering analysis of the vehicle will be carried out to establish any vehicle improvements or modifications required for operation on the CN line. An assessment will be made of special equipment requirements and the associated design carried out (e.g., drawbar for vehicle retrieval).

2.2.5 Vehicle Modifications

Any modifications required as a result of negotiations and agreement with CN/CTC to meet regulatory requirements will be incorporated. In addition modifications necessary for operation on INCO Railway Line will be implemented.

An engineering evaluation of test results will be conducted and based on the findings simple modifications will be incorporated and tested. Current projections envisage at least one lateral ride improvement, retest, and provision of rail sanders.

2.2.6 Operating Rules, Practices and Plan

A set of recommended rules and operating practice for operation on the Thompson-Thicket-Portage-Pikwitonei line will be developed and documented. This will include a plan to implement the chosen operational strategy, including baggage transport and passenger survival equipment and procedures in the event of vehicle breakdown.

2.2.7 CN and CTC Acceptance

CN and CTC acceptance of the railbus operation will be gained and documented based on recommended operating procedures, engineering analysis, and test results.

2.2.8 Project Control

The project will be controlled by regular team meetings, assessment of the completion of each test against the planned targets, estimate of work remaining and preparation of progress and interim reports as required.

2.2.9 Final Report (Test Phase)

A Final Report for the testing and operations phase will be prepared including:

- Experience relating to the accumulation of 3,000 km of operational testing on the INCO Rail Line;

- o Summary of all testing and test results for the railbus prior to its modifications;
- o Summary of all testing and test results for the railbus after its modifications;
- o Establishment of vehicle maximum safe operating speed on both tangent and curved track;
- o Approximate fuel and energy consumption results;
- o Recommended rules and operating practices for operation on the specified CN Rail Line;
- o Derailment recommendations and emergency rescue/service procedures;
- o Identification of the first level options for passenger survival, baggage transport and operational strategies; and
- o Recommendations for the following phase of work which will include additional equipment to be supplied and installed prior to the demonstration passenger service operation on the specified CN Rail Line.

The final report for the testing phase will also contain a plan to implement the chosen operational strategy for non-revenue passenger service demonstration first identified in the planning phase

2.3 SCHEDULE

The overall schedule is shown in Table 2.1. The program will be completed within three months between a nominal start of work planning 29 July and anticipated completion 28 October.

This compressed schedule assumes a go-ahead for the testing phase at the end of week 5 (30 August).

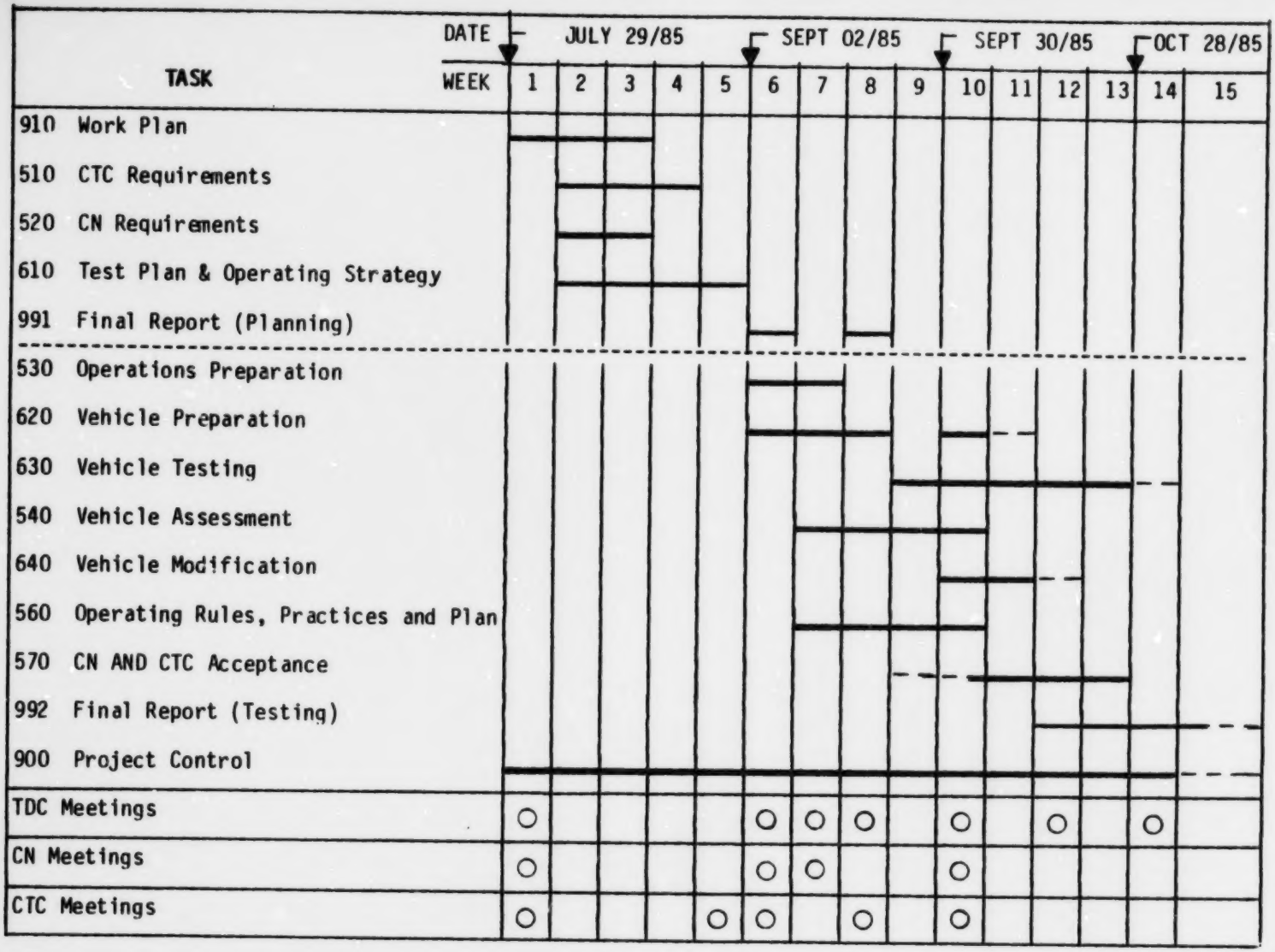

TABLE 2.1: PROGRAM SCHEDULE FOR PLANNING AND TESTING PHASES

3.0 THE TEST PLAN

The test plan is described in some detail in Appendix A1 according to a standard TTL format. The tests to be carried out are described in summary form below.

3.1 NOISE

The purpose of the test is to measure "A" weighted sound levels at prescribed worst case locations and operating modes, both on-board and wayside. To ensure a practical test, noise levels will be measured using a calibrated hand held meter only in locations of specific interest. These locations are typically as follows:

- On-board
  at five points in the vicinity of driver's and passenger's heads when seated normally.

- Wayside
  in locations and modes consistent with standard transit noise level measurement practice, typically 15 m to the side and 1.5 m above top of rail.

The tests will be carried out at several vehicle speeds.

3.2 VIBRATION

The purpose of the test is to generate data that will enable engineering assessment of the wheel bearings with respect to life under service conditions. Ideally, vertical acceleration of the subject wheel would be measured directly, however, this direct measurement would likely be rather expensive and time consuming. Because of the comparative stiffness of the axle assembly, measurement of vertical accelerations of the bearing housing close to the wheel are believed to be sufficient for an engineering evaluation of bearing performance and life.

3.3 RIDE QUALITY

To evaluate ride quality, it will be necessary to compare it to a recognized industry standard. For this test, the British Rail Ride Index will be the standard used. Measurements will be made at floor level above both axles, where practical, and at a vehicle mid-point at various operating speeds.

A section of track will be selected in reasonable condition, and tangent for sufficient length to allow 10 second runs at highest speeds intended.

3.4 WHEEL/RAIL INTERFACE

The wheel/rail interface tests have the objective of determining safe operating speeds under different circumstances. The vehicle will be equipped with video cameras (4) and monitors (2) to carefully monitoring the action of the wheel/rail interface; potential derailment tendencies and stability problems will be identified and recorded.

- o Stability will be determined by observation of wheel/rail interface and vehicle behaviour at differing speeds.
- o Curving behaviour will be determined by observing the tendency of wheel flanges to climb the rail on different radius curves representative of the CN railway line.
- o Switching behaviour will be determined by observing from the on-board monitors the tendency of the wheels to derail, sustain damage or follow the wrong alignment. Several different switches will be chosen for this test and vehicle behaviour will be recorded at different speeds.

3.5 FUEL CONSUMPTION

The purpose of this test is to measure fuel consumption for comparison with other vehicles. Fuel consumption will be determined by operating the vehicle in a manner similar to revenue service over a period of time and measuring the fuel used versus distance travelled. The determination of fuel used will be by topping off the tank in the same vehicle position and orientation and using a calibrated fuel container.

3.6 RELIABILITY AND WEAR

The objective of these tests will be to establish the level of reliability and initial wear rates of bearings and wheels over approximately 3000 km of operation. Wheels will be inspected and profiles taken before and after the tests are completed for damage and wear. Bearings will be stripped and inspected for wear and damage before and after the testing. In addition, periodic checks for wear and damage of the bearings will be made by jacking the vehicle and checking for "play". Periodic inspections will be carried out if required by the engineering assessment.

3.7 RERAILING

In order to provide for contingencies it is necessary to evaluate different rerailing techniques. In the absence of an established method for rerailing this particular vehicle, INCO equipment and assistance will be employed during several trial and error exercises to determine the most satisfactory method. The procedure will be documented and equipment requirements identified.

3.8 TURNTABLE SYSTEM

The purpose of the test is to verify satisfactory design and operation by a single operator. The best method of testing the turntable system is to operate the system, and closely observe the operation for satisfactory and safe operation. The effects of vehicle "Centre of Gravity" will be observed and mechanical integrity of the hardware monitored.

3.9 EMERGENCY AUXILIARY OPERATION

The purpose of this test is to determine the period of time over which the vehicle battery can provide emergency power for essential systems and maintain adequate vehicle internal temperatures during winter conditions. The three main criteria influencing the period of time during which a battery is capable of energizing a system are:

a) the starting condition of the battery, by which is meant the specific gravity, the temperature, etc.;

b) the capacity of the battery (area of plates, volume of electrolyte);

c) load current.

For the purpose of this test, it is assumed that item b), battery capacity, is fixed and that item a), starting condition is fixed by definition of S.G. and terminal voltage.

The results of the test, therefore, is dependent on item c), load current. Load current is dependent on load resistance. The load will consist of some D.C. motor driven blower(s) and some incandescent emergency lighting. The emergency system's "worst case" will be assumed, i.e., some internal lights, external marker lights, emergency heater and blower. The test must establish the time required for the emergency lighting subsystem to become inadequate and, similarly, the time required for blower output to fall to an unacceptable level.

3.10 DRAW-BAR

The objective of the test is to verify satisfactory draw-bar operation. The draw-bar will be tested by utilizing the draw-bar on each end of the vehicle and observing for safe, satisfactory operation. After these tests, the draw-bar and vehicle attachment areas will be examined for cracks or damage.

3.11 DEADMAN SWITCH

The objective of the test is to verify deadman switch operation. The deadman switch is designed to bring the vehicle to an emergency stop when the operator is incapacitated. Testing this switch will be carried out by tripping at different speeds and measuring the elapsed time from tripping to bus standstill.

3.12 EMERGENCY ENGINE AND POWER SHUT-OFF SWITCH

The purpose of the test is to verify satisfactory engine and power shut-off switch operation. The emergency engine and power shut-off switch is designed to allow the operator to shut down the engine and auxiliary electrical power system quickly, if required. Testing will be carried out by tripping the switch at different RPMs and measuring elapsed time to engine standstill.

4.0 TECHNICAL AND REGULATORY REQUIREMENTS

4.1 GENERAL

The major issues of concern are the technical and operational requirements to be addressed before passenger service operations can commence on a specified CN Railway Line. Targeted for November 1985, preliminary non-passenger testing will tentatively take place between Thompson-Pikwitonei-Thicket Portage on the CN Rail Line using the WCSS Railbus vehicle.

Generally, it has been agreed that for the initial test period by CN, CTC and TDC that the vehicle will be treated as a train and will operate under the Manual Block System (MBS) while on the specified CN line near Thompson, Manitoba.

A review was undertaken of past correspondences between CN, CTC, VIA and TDC regarding the operation and technical requirements of the Railbus before approval for operation on the non-signalled territory can be granted. Specifically, the vehicle would be required to address in full or in part, not only a detailed list of technical issues stated by CN but also conform to certain requirements as indicated by CN and CTC and as stated in the Uniform Code of Operating Rules, the Railway Act, the CTC General Orders, the CTC Regulations, and specific Canadian National Railways Training Standards.

4.2 IDENTIFIED REQUIREMENTS

The following tables contained in this section (Tables 4.1 to 4.4) outline the issues raised by CN and CTC as far as technical and operational requirements are concerned for the present state of the WCSS Railbus. TTL's response/proposal to the specified requirements are also identified as to whether vehicle modification will or has occurred in the specified areas or, whether a request for relief from the requirement would be requested from the CNR or CTC's regulatory authorities.

TABLE 4.1: CN RAIL TECHNICAL RECOMMENDATIONS; FOR TEST PERIOD ONLY

SUBJECT	CN'S REQUIREMENTS	PROPOSAL TO CN
Wheel Bearings	o Concerned with adequacy of automotive type wheel bearing, life expectancy, and premature failure of wheels.	o Will provide detailed analysis of adequacy of design. o Will provide routine inspections of bearings for wear/temperature changes. o Will determine from tests on INCO Line lateral and vertical forces imparted to bearings, wheels and axles.
Curving Ability	o Concerned about derailment potential and vehicles' ability to negotiate curves and switches. o Concerned about vehicle speed restriction on curved track.	o Will provide video monitoring of wheel/rail interface when following curves and track switches. o Will measure lateral axle forces to establish maximum safe operating speeds in curves. o Will further modify suspension to determine level of improvement on lateral ride quality.
Braking	o Concerned with wheel locking during braking. o Concerned with braking during winter operations.	o Brake air pressure has been reduced to provide the required rate without wheel locking. o Wheel/rail interface will be monitored during brake tests. o Wheel sanders will be added to aid in braking.

TABLE 4.1: CN RAIL TECHNICAL RECOMMENDATION; FOR TEST PERIOD ONLY

SUBJECT	CN'S REQUIREMENTS	PROPOSAL TO CN
Maximum Vehicle Speed	o Concerned with vehicle's ability to maintain stability up to maximum speed restrictions on tangent track.	o Will monitor wheel/rail interface and measure lateral and vertical forces on axles and vehicle to determine safe maximum speed. o Vehicle ride quality will be measured and indexed using a calibrated commercially accepted standard meter (British Rail). o Will submit test results to CN Mechanical Department for approval upon request.
Enclosed Driver Area	o Concerned with safety of driver during passenger service.	o Will provide protective (clear lexan) screen between driver and passenger areas prior to demonstration passenger service on CN line, if so required by CN.
Vehicle Suspension	o Concerned with wheel lift and cross level variations.	o Wheel/rail interface will be video monitored during various crossing and level variation tests. o Lateral forces on axles and wheels will be measured during tests.
Vehicle Traction	o Concerned about traction of vehicle over snow and ice in winter operation.	o Pilot has been added to front of vehicle and adjusted to recommended height above rail. o Wheel sanders will be added to aid in traction and braking. o Wheel/rail interface will be video monitored during testing and adverse winter conditions prior to demonstration passenger service.

TABLE 4.1: CN RAIL TECHNICAL RECOMMENDATION; FOR TEST PERIOD ONLY

SUBJECT	CN'S REQUIREMENTS	PROPOSAL TO CN
CN Radio	o Vehicle to be equipped with a two-way radio capable of transmitting and receiving on CN channels.	o The vehicle will be equipped with a suitable radio with sufficient range prior to entering onto CN track.
Derailment Beams	o Vehicle to be modified with telescopic beams to support the vehicle/weight, during derailment, when a crane is required to lift the vehicle. o Four spreader beams to be manufactured for derailment use.	o The vehicle will be tested for appropriate derailment procedures using rail-jacks. o Attachments will be added to the top of the four wheel wells and tested for emergency service prior to further vehicle modifications and addition of telescopic spreader beams.
Emergency Supplies	o Vehicle to be equipped with blankets, stretcher, first aid kits, fire extinguisher, auxiliary lighting, axle and tow chain.	o The vehicle will be fitted with all of the suggested safety supplies prior to demonstration passenger service.

TABLE 4.2: WCSS RAILBUS; CTC TECHNICAL REQUIRMENTS FOR OPERATION ON CN LINE, THOMPSON, MANITOBA; FOR TEST PERIOD ONLY

SUBJECT	CTC'S REQUIREMENTS	PROPOSAL TO CTC
Regulation O-8 Section 11 (1) and (2)	o Vehicle to be equipped with a full set of flagging signals, engine whistle and timetable.	o The conductor will bring his own flagging kit, whistle and timetable since he will form part of recommended two-men crew.
General Order O-14	o Vehicle to be equipped with a pilot.	o The vehicle has been fitted with a pilot and mounted at the minimum height restriction above top of rail (70 mm).
General Order O-14 UCOR Rules 17, 17A, 17B, 17C, and 17D	o Vehicle to be equipped with a headlight and dimmer front and rear, and at the required illumination. o Spare parts for lamps.	o The vehicle has been fitted with appropriate headlights, front and rear, and have the required illumination. o All headlights are under driver control and a hi-lo dimmer switch. o Spare lamp parts will be available on vehicle.
General Order O-14	o Vehicle to be equipped with classification lights.	o The vehicle has been fitted with the appropriate size of white classification lights at the locations required.
General Order O-21	o Vehicle to be equipped with a deadman control.	o The vehicle has been equipped with a driver operated and controlled foot switch which when released, automatically idles the engine, disengages the transmission and gradually applies the service brakes.

TABLE 4.2: WCSS RAILBUS; CTC TECHNICAL REQUIRMENTS FOR OPERATION ON CN LINE, THOMPSON, MANITOBA; FOR TEST PERIOD ONLY

SUBJECT	CTC'S REQUIREMENTS	PROPOSAL TO CTC
General Order 0-25 of the Railway Act UCOR Rule 30	o Vehicle to be equipped with a bell.	o Request relief from this requirement. Reason o Bell was originally intended to alarm track and near-by personnel of locomotive's approach because engineer was not always able to clearly view track area immediately in front due to cab location. o Design of railbus gives the driver a clear view of the track area and can easily warn nearby personnel with an electrical horn and auxiliary air horn. o In addition, a back-up alarm has been installed to warn of vehicle's approach in reverse. o There are no public crossings within test area. o Railbus can stop within 200 ft from 40 mph.
General Order 0-25 of the Railway Act UCOR Rule 14	o Vehicle to be equipped with a horn.	o The vehicle has been fitted with a suitable air-horn as specified.
UCOR Rule 19 and 19A	o Vehicle to be equipped with markers	o The vehicle has been fitted with the appropriate red and green lights as specified at the locations required and under driver control.

TABLE 4.2: WCSS RAILBUS; CTC TECHNICAL REQUIRMENTS FOR OPERATION ON CN LINE, THOMPSON, MANITOBA; FOR TEST PERIOD ONLY

SUBJECT	CTC'S REQUIREMENTS	PROPOSAL TO CTC
UCOR Rules 20 and 21	o Vehicle to be equipped to display green and white flags and lights.	o Vehicle will be operated in MBS territory and flags are not necessary but will comply, if so required by CTC. o Markers, classification lamps and flagging signals will be installed prior to operation on CN line.
Regulation 0-10	o Vehicle to be equipped with sill-steps, hand-holds, ladders, running boards, and other safety appliances.	o Request relief from requirement. Reason o Vehicle will not be coupled to other passenger carrying vehicles while in service. o There is no requirement for train personnel to walk on top of or to rear of vehicle from outside of vehicle during normal operations. o Inside walkway is available. o Fold-down step is fitted to vehicle at entrance door for passenger and crew convenience.
Regulation 0-10	o Vehicle to be equipped with a device (coupler) attached to either end of the bus and which can be reliably coupled to any standard railway coupler.	o The vehicle has been modified to accept a relatively light drawbar attachment (device) to either end of the bus. o Its method for use and capabilities will be demonstrated during tests on INCO line.

TABLE 4.2: WCSS RAILBUS; CTC TECHNICAL REQUIRMENTS FOR OPERATION ON CN LINE, THOMPSON, MANITOBA; FOR TEST PERIOD ONLY

SUBJECT	CTC'S REQUIREMENTS	PROPOSAL TO CTC
Regulation 0-10	o Vehicle to be equipped with a hand-brake which can be operated while bus is in motion.	o The vehicle has been fitted with a driver operated hand-brake which can be safely activated at any time.
Regulation 0-18 9	o Vehicle to be fitted with a protective barrier for the engineer to isolate himself from the passengers if desired.	o The vehicle will be fitted with the barrier prior to demonstration passenger service.
Regulation 0-27	o Fire extinguishers, sledge, axe, and saw are required.	o The vehicle has been fitted with the fire extinguisher and will also carry a sledge, axe and saw as required prior to demonstration passenger service.
Regulation 0-28	o Vehicle to be fitted with spark arresting system.	o Request relief from this requirement. Reason o The diesel engine being used does not emit sparks. o Exhaust pipe is very long and will trap and cool gases and debris emitted from engine.

TABLE 4.3: CN RAIL OPERATIONAL RECOMMENTATIONS AND REQUIREMENTS; FOR TEST PERIOD ONLY

SUBJECT	CN'S REQUIREMENTS	PROPOSAL TO CN
Restricting Speed on Tangent Track	o Vehicle to be restricted to a speed limit between 35 and 40 mph on tangent track. o Speed restrictions on curved tracks are - 20 mph, up to 5° curve - 10 mph, between 5° and 10° curves - 5 mph, greater than 10° curve.	o Vehicle maximum safe operating speed will be determined in tests as agreed to with CN. Vehicle will obey published speed restrictions set-out in CN specified timetable. o If tests shown higher speeds than in published timetables are obtainable in a safe manner, appropriate exemptions will be requested from CN.
Vehicle Crewing	o No outside parties to operate vehicle on CN property. o Two-man crew is to be used. o Training of operators by CN.	o Following the tests, a one-man crew (CN A-Book qualified) will be requested to operate the vehicle.
Vehicle Servicing	o Vehicle servicing and maintenance is to be performed by other than CN personnel. o Servicing level and interval to be agreed to by CN. o CN will perform checks and inspections. o CN will require an inspection report at three month intervals on the dismantling of the wheels, wheel changes, and bearing condition.	o Vehicle servicing and maintenance will be with Rail/bus qualified personnel. o Servicing levels, procedures and frequency will be provided to CN upon request. o Periodic spot inspections by CN is encouraged. o Three month service reports will be provided if requested on wheel/bearing conditions.

TABLE 4.3: CN RAIL OPERATIONAL RECOMMENTATIONS AND REQUIREMENTS; FOR TEST PERIOD ONLY

SUBJECT	CN'S REQUIREMENTS	PROPOSAL TO CN
Operating Safety	o Use of Manual Block System can be adapted.	o Vehicle will operate as a train under MBS standards.
Level Crossings	o Vehicle operations at level crossings to be established.	o No signals on specified route. o Present procedures at level crossings will include: o Sounding of horn o Reduce vehicle speed to a maximium 15 mph before crossing. o Stop at crossing if road vehicle entering or moving on railway right-of-way.
Passengers	o No revenue passengers are to be carried until CN approves safety of vehicle.	o No passenger service will be allowed prior CN approval.
Rescue Operations	o Plan to be given prior to passenger service as to rescue of passengers and necessary equipment.	o CTC and CN safety regulations have been reviewed and vehicle will be fitted prior to service with appropriate emergency equipment including blankets, first aid kits, fire extinguisher, stretcher and tow chain. o Arrangements for re-railing and vehicle rescue services will be put into place.

TABLE 4.3: CN RAIL OPERATIONAL RECOMMENTATIONS AND REQUIREMENTS; FOR TEST PERIOD ONLY

SUBJECT	CN'S REQUIREMENTS	PROPOSAL TO CN
Winter Operations	o Concerned about traction of vehicle over ice and snow. o Concerned with railway crossing due to ice and snow accummulations from road clearing equipment. o Concerned with passenger safety if engine fails during winter conditions.	o Vehicle will be fitted with wheel sanders to improve traction and it's ability demonstrated during winter tests on INCO line. o There are limited road crossings on the specified route and vehicle's ability will be winter tested on the INCO and CN lines which has similar crossings. o Vehicle has been modified with additional winter protection for turntable reliability and passenger comfort (auxiliary heater).

TABLE 4.4: CTC OPERATIONAL REQUIREMENTS AND RECOMMENDATIONS; FOR TEST PERIOD ONLY

SUBJECT	CTC'S REQUIREMENTS	PROPOSAL TO CTC
Regulation 0-8 Section 13	o Vehicle to be accompanied by a conductor.	o A CN A-Book qualified conductor will be employed for initial testing on the specified CN line.
Regulation 0-16	o Vehicle will be carefully inspected after each day's work. o Before each trip, the brakes are to be verified for proper operation.	o Vehicle will be daily inspected for operation of brakes, propulsion, turntable and other necessary equipment. o Vehicle (engine and transmission) will be serviced as per manufacturer's recommendation. o Wheels and bearings will have periodic inspections for wear and deterioration.
Regulation 0-17	o Air pressures and reservoirs must be safety inspected and tested.	o Vehicle air-brake equipment will have routine checks for performance and operation. o Air pressures and reservoirs will be included in inspection.

4.3 DISCUSSION

In summary, prior to operational testing of the Railbus at INCO, the vehicle design does not currently conform to the combined requirements of the CTC and CN in the following areas:

- deadman control;
- bell;
- sill steps;
- ladders;
- running boards;
- classification lights;
- sparks arresting system;
- hand holds; and
- coupling device.

The deadman control, classification lights and a suitable coupling device will be installed. The vehicle is presently equipped with a driver activated drop-down step for passenger convenience and safety. Other items mentioned in the previous paragraph are considered non-essential for this specific application.

Additional requests were made by the CNR for:

- protective barrier for the operator;
- daily inspection and maintenance of the vehicle; and
- modifications to support the vehicle weight for rerailing purposes in the event of a derailment.

These requests will be further considered and implemented, if so requested by CN, prior to operation on CN Rail's Thompson Line.

In consideration of the CN test area, and the absence of centralized traffic control, crossing protection signals and public crossings at grade, justification for relief on the items indicated below appears in order:

- Bell;
- Sill steps;
- Ladders;
- Running boards;
- Spark arresting device; and
- hand holds.

5.0 OPERATIONAL STRATEGIES

5.1 OBJECTIVES

The overall purposes of the program is to provide a safe, reliable, new form of transportation which can be placed into operational passenger service for remote communities. In order to achieve this overall goal a logical progression from operational requirements through design, test and demonstration is required. In parallel with, and interacting with, the hardware development activities there is the equally important requirement to develop the software, i.e., operational strategies, required to operate this new vehicle in a safe manner in a real environment rather than a test track.

In this section a preliminary outline of operation on the Thompson - Thicket Portage - Pikwitonei CN line is developed and some longer term issues addressed.

The objectives of operation on the CN line would be achieved in two stages.

The objectives in the first stage would be to:

- o Demonstrate Railbus operation in a real railway environment;
- o Develop and test operating procedures;
- o Train personnel in railbus operation; and
- o Uncover and rectify vehicle and operational deficiencies.

In the second stage the objective would be to:

- o Carry out preliminary passenger carrying trials in a non-revenue generating manner in order to determine user reaction to the service.

A successful demonstration would enable resolution of technical and institutional issues raised by the introduction of the railbus and allow adjustment or refinement of the work being conducted in other TDC projects to provide suitable technology for broad Canadian Railbus use.

5.2 OPERATIONAL MODE

The location of the demonstration will be a local service between Thompson, Manitoba and two outlying communities, namely Thicket Portage and Pikwitonei. This area is shown in Figure 2. The two outlying communities each have a population of 200 and Thompson itself acts as a commercial hub for the whole region with a population of 15,000.

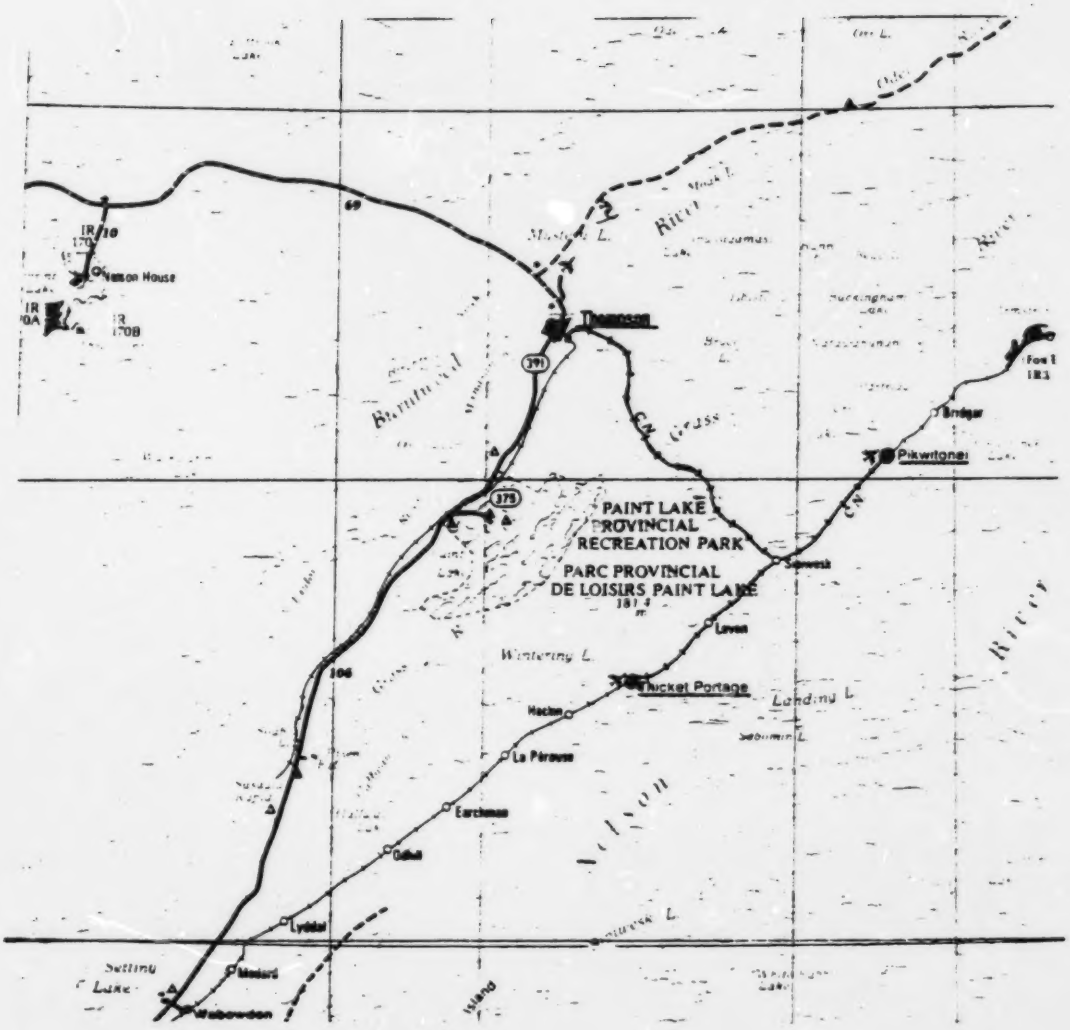

FIGURE 2: PROPOSED SERVICE LOCATION

COMMUNITY	DEPART*	ARRIVE*	STOPOVER TIME AVAILABLE IN COMMUNITY (without overnight)
Thompson	6:00 a.m. (11:00 a.m.) 4:00 p.m.	10:40 a.m. (3:40 p.m) 8:40 p.m	5 hours
Thicket-Portage	7:50 a.m. (12:50 a.m.) 5:50 p.m.	7:40 a.m. (12:40 a.m.) 5:40 p.m.	10 hours
Pikwitonei	9:00 a.m. (2:00 p.m.) 7:00 p.m.	8:50 a.m. (1:50 p.m.) 6:50 p.m.	10 hours

TABLE 5.1: PRELIMINARY TIMETABLE

*Note: This preliminary timetable is based solely on what would be possible using an average vehicle speed of 50 kph. A detailed timetable will be developed in conjunction with CN/CTC and VIA.

The demand is anticipated to be approximately 20 passengers from each community visiting Thompson each day. The distances involved (210 km roundtrip) and anticipated service speed of an average 50 kph would allow two roundtrips (or eventually 3) per day with early morning and late afternoon departures from Thompson. A preliminary timetable based solely on these considerations is shown in Table 5.1. In later program tasks a definitive operating timetable will be developed in conjunction with CN, VIA and the CTC. Factors that will be taken into account are the timetable for existing freight and passenger traffic and safety considerations such as vehicle headway. A stopover of 5 hours in Thompson would appear to be possible to transact business, shop, etc.

It is currently envisaged that initially there will be a two-man crew consisting of a CN trained engineman and conductor. It is however a program objective to operate with a one man crew. It is anticipated that the vehicle will be stored in a purpose built shed at INCO or on land leased from CN by the Manitoba Department of Highways and Transportation near the current VIA station at Thompson. Maintenance would be carried out between themorning and evening runs except for bus cleaning and fuel top-off carried out last thing at night.

In summary, the vehicle could operate for up to approximately eight hours and 400 km daily. It is currently the plan not to operate Sundays or on days when VIA provides a passenger service as the operation is intended to be a complementary service.

5.3 MAINTENANCE AND EQUIPMENT

Vehicle maintenance activities will consist of:

- Visual check of exterior, interior and underframe once daily;
- Pre-run brake and lights test;
- Top-off fluid levels clean interior and empty toilet once daily;
- Safety inspection of all safety related equipment once weekly including functional tests (including wheels, bearings, axles, turntable, brakes, lights, etc.);
- Response to driver/conductor observed faults at end-of-run;
- Vehicle external clean once weekly;
- Daily record keeping including completed check lists of maintenance activities, record of miles and trips completed, fuel and other consumables, observations, weather, etc.; and
- Engine and transmission maintenance to manufacture's schedule.

Spare parts will be stored in the maintenance and storage facility including at a minimum:

- Engine and transmission oils and filters;
- Fuel and air filters;
- Engine fan, alternator and water pump belts;
- Spare wheels (4);
- Spare bearings (4 sets) and bearing grease (low temperature);
- Rear axle oil;
- Universal joints (drive-line);
- Service and emergency brake shoes and spare parts;
- Spare lamps, bulbs and other small electrical equipment;
- Interior and exterior touch-up paint;
- Interior seat trim repair kit;
- Spare windshield wiper blades;

- o Spare window transparencies; and
- o Hydraulic hoses, filters, fittings, oil etc.

In addition to equipment being fitted to the vehicle during the INCO test program it is currently anticipated that the following additional equipment will be determined to be necessary and would be fitted prior to operation on the CN line:

- o CN two-way radio;
- o Rerailing equipment according to recommendations developed during test phase;
- o Equipment for one-man operation of the turntable and re-railment winch mechanism; and
- o Driver's safety screen according to design developed during the INCO testing phase.

5.4 RESOURCES

A preliminary estimate of on-site manpower requirements is as follows:

- o Mechanic, four-hours/day (local subcontract);
- o Operations Manager, eight-hours/day (planning & record keeping);
- o Driver & Conductor, ten-hours/day each (split shift); and
- o Test Engineer, five-days/month (test data, wheel profiles, etc.).

5.5 SCHEDULE

A preliminary schedule based on gradual introduction of the vehicle is shown below in Figure 3:

MONTH / ACTIVITY	1985 NOV	DEC	1986 JAN	FEB	MAR
One run per day with no passengers*	=========				
Additional equipment installation	=========				
Two runs per day with no passengers (excepting demonstration rides)*		==========	==========		
Two runs per day with passengers (non-fare paying)				==========	==========

FIGURE 3: PRELIMINARY DEMONSTRATION SCHEDULE

*Note: Some of the winter testing and certainly driver familiarization with the vehicle could be carried out on the INCO railway line.

5.6 PRIOR ARRANGEMENTS

The following arrangements would have to be made in order to demonstrate the vehicle:

- o CN approval of vehicle and operation during INCO test phase;
- o CTC approval of vehicle and operations during INCO test phase;
- o Contract with CN for use of tracks facilities and supply of a qualified crew; and
- o Use of near-by winterized facility for maintenance and storage.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

The following is concluded from the work carried out in the planning phase:

- o In their present form, the rules and regulations for railway operation do not address the design and specifics of the proposed vehicle classification represented by the railbus but address conventional equipment;

- o Relief from some CTC and CNR requirements would seem to be appropriate in the interim for railbus testing and operation without any relaxation of safety standards. Based on their relevance in the remote service environment, relief is required in the following areas:

  - Bell;
  - Sill steps;
  - Ladders;
  - Running boards;
  - Spark arresting devices;
  - Hand holds;
  - Buff loads; and
  - AAR couplers.

- o The program of work to test the vehicle on the INCO railway line will take three months including the herein reported planning phase;

- o Three months of winter testing on the CN and INCO railway lines are required before passenger operation;

- o A demonstration with two round trips per day is possible with the vehicle being stored overnight in Thompson. Passengers from the outlying communities would be able to spend some five hours in Thompson without an overnight stay. Approximately two months of operation would provide the necessary operational experience.

6.2 RECOMMENDATIONS

The following is recommended from the work carried out in the planning phase:

- o Action should start on a new set of vehicle classification requirements represented by the railbus for future operation; and

- Arrangements should be carried through with the CTC, CNR, INCO and the Manitoba Department of Highways and Transportation in order for a non-revenue passenger service demonstration to commence on the Thompson-Pikwitowei-Thicket Portage Line of CN Rail, preceded by a non-passenger carrying test phase.

7.0 REFERENCES

1) DSS Contract Serial No. OSD85-00086 "Plan for Testing of WCSS Railbus on INCO Railway Line", July 1985.

2) DSS RFP File No. 11DS.T8200-5-5528 "Operational Testing of WCSS Railbus on INCO Railway Line", August 1985.

3) "Technical Proposal for the Development of a Canadian Railbus", UTDC R&D Ltd., July 1985.

4) Central Filing System Instruction - UTDC R&D Ltd.

5) Documentation supplied by TDC.

APPENDIX A-1

TEST PLAN FOR TESTING OF WCSS RAILBUS

ON INCO RAILWAY LINE

TEST PLAN FOR TESTING OF WCSS RAILBUS ON INCO RAILWAY LINE

Report No.: 338-610-001

Issue No.: 1

Copy No.:

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Date: 85/09/18

SUMMARY

It is planned to perform tests on a bus modified with steel wheels to run on standard gauge railway tracks.

These tests will provide baseline data from which it will be possible to judge the merit of future modifications to this bus and to form a basis for comparison with other vehicles.

The Test Procedures and Requirements outlined in this report follow a standard format used by TTL, which is sufficiently detailed for test personnel to carry out the program. Individual tests such as the stability tests will be the subject of self-contained test reports which will include the procedure followed, site and vehicle status and all test results.

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1.0 BACKGROUND

A Western Flyer bus owned by Transport Canada has been converted for operation on railway tracks by Winnipeg Coach Sales and Service (WCSS) Ltd. This vehicle is intended to serve as a test vehicle for resolution of institutional and regulatory issues, evaluation of related engineering design concepts and to assess the overall feasibility of railbus operations in northern remote communities. A demonstration passenger service is planned for northern Manitoba in November 1985, linking Thicket Portage and Pikwitonei with the City of Thompson.

Preliminary operational tests have been conducted by WCSS on the tracks of the Greater Winnipeg Water District Railway in Winnipeg, Manitoba. For the next stage of development testing, the railbus will undergo a series of intensive operational trials on railway lines owned by INCO Limited located in Thompson, Manitoba. The performance and reliability of the vehicle are to be closely monitored during these trials in order to assess its design, and operating characteristics in consideration of the proposed objectives.

2.0 PURPOSE

The purpose of this report is to outline the areas of vehicle testing as determined in TTL Report No. 338-910-001, "Detailed Work Plan for Testing of WCSS Railbus on INCO Railway Line". The report is not intended as an Instruction Manual on how the tests will be carried out, but rather as a General Guideline in sufficient detail for TTL Test Personnel (who are familiar with the format) to carry out the work.

2.1 NOISE

To measure "A" weighted sound levels at prescribed worst case locations and modes both onboard and wayside.

2.2 VIBRATIONS

To allow engineering assessment of wheel bearing performance requirements.

2.3 RIDE QUALITY

To quantify ride comfort to a recognized standard.

2.4 WHEEL/RAIL INTERFACE

2.4.1 Stability

To determine if vehicle remains stable up to and including the desired operational speed of 80 km/h (50 mph).

2.4.2 Curving Behavior

To identify any tendency to derail.

2.4.3 Switching Behavior

To identify any tendency to derail, damage switches or follow wrong alignment.

2.5 FUEL CONSUMPTION

To determine fuel consumption in general service.

2.6 RELIABILITY AND WEAR

To establish level of reliability and initial wear rates of bearings and wheels over approximately 3000 km (1800 mi) of operation.

2.7 RERAILING

To evaluate different rerailing techniques.

2.8 TURNTABLE SYSTEM

To verify satisfactory turntable system, design and operation by a single operator.

2.9 ENERGY

To determine period of time over which the vehicle battery can provide emergency power for essential systems and maintain adequate vehicle internal temperature in winter conditions.

2.10 DRAW-BAR OPERATION

To verify satisfactory draw-bar operation.

2.11 DEADMAN SWITCH

To verify deadman switch operation.

2.12 EMERGENCY ENGINE AND POWER SHUT-OFF SWITCH

To verify satisfactory emergency engine and power shut-off switch operation.

3.0 EXAMINATION OF APPROACHES

3.1 NOISE

To ensure retention of the practical nature of the test, noise levels will be measured only in locations of specific interest. These locations are typically as follows:

- On-board
  in the vicinity of driver's and passenger's heads when seated normally.

- Wayside
  in locations and modes consistent with standard transit noise level measurement practice.

3.2 VIBRATION

Ideally, vertical acceleration of the subject wheel would be measured directly, however, this direct measurement would likely be rather expensive and time consuming. Because of the comparative stiffness, measurement of vertical accelerations of the bearing housing close to the wheel are believed to be sufficient for an engineering evaluation of bearing performance and life.

3.3 RIDE QUALITY

To evaluate ride quality, it will be necessary to compare it to a recognized industry standard. For this test, the British Rail Ride Index will be the standard used.

Track selected should be in reasonable condition, and tangent for sufficient length to allow 10 second runs at highest speeds intended.

3.4 WHEEL/RAIL INTERFACE

By carefully monitoring the action of the wheel/rail interface, potential derailment tendencies and stability problems can be identified.

3.4.1 Stability

Stability will be determined by observation of wheel/rail interface and vehicle behaviour at differing speeds.

3.4.2 Curving Behaviour

Curving behaviour will be determined by observing the tendency of wheel flanges to climb the rail on different radius curves.

3.4.3 Switching Behaviour

Switching behaviour will be determined by observing the tendency of the wheels to derail, damage or follow the wrong alignment through several different switches to be chosen for this test.

3.5 FUEL CONSUMPTION

Fuel consumption will be determined by operating the vehicle in a manner similar to revenue service over a period of time and measuring the fuel used versus distance travelled.

3.6 RELIABILITY AND WEAR

Wheels will be inspected and profiles taken before, periodically during, and after the testing is completed for damage and wear.

Bearings will be stripped and inspected for wear and damage before and after the testing. In addition, periodic checks for wear and damage of the bearings will be made by jacking the vehicle and checking for "play". Periodic inspections will be carried out if required by the engineering assessment.

3.7 RERAILING

In the absence of an established method for rerailing the vehicle, trial and error technique will be used to determine the most satisfactory method.

3.8 TURNTABLE SYSTEM

The best method of testing the turntable system is to operate the system, and closely observe the operation for satisfactory and safe operation.

3.9 ENERGY

The three main criteria influencing the period of time during which a battery is capable of energizing a system are:

a) the starting condition of the battery, by which is meant the specific gravity, the temperature, etc.;

b) the capacity of the battery (area of plates, volume of electrolyte);

c) load current.

For the purpose of this test, it is assumed that item b), battery capacity, is fixed by part number, source control drawings, etc.; and that item a), starting condition is fixed by definition of S.G. and terminal voltage.

The results of the test, therefore, is dependent on item c), load current. Load current is dependent on load resistance. The load is believed to consist of some D.C. motor driven blower(s) and some incandescent emergency lighting. In the absence of other definition of what load constitutes "emergency systems" worst case must be assumed, i.e., auxiliary internal lights, external marker lights, auxiliary heater and blower(s). The test must establish the time required for the emergency lighting subsystem to become inadequate and, similarly, the time required for blower output to fall to an unacceptable level.

3.10 DRAW-BAR

The draw-bar will be tested by utilizing the draw-bar on each end of the vehicle and observing for safe, satisfactory operation. After these tests, the draw-bar and vehicle attachment areas will be examined for cracks or damage.

3.11 DEADMAN SWITCH

The deadman switch is designed to bring the vehicle to an emergency stop when the operator is incapacitated. Testing this switch will be carried out by tripping at different speeds and measuring the elapsed time from tripping to bus standstill.

3.12 EMERGENCY ENGINE AND POWER SHUT-OFF SWITCH

The emergency engine and power shut-off switch is designed to allow the operator to shut down the engine and auxiliary electrical power system quickly if required. Testing will be carried out by tripping the switch at different RPMs and measuring elapsed time to engine standstill.

4.0 TEST VARIABLES

4.1 NOISE

4.1.1 On-Board

- o Engine speed
- o Engine acceleration position
- o Transmission mode
- o Vehicle speed
- o Vehicle load
- o Vehicle condition (with and without modifications)
- o Auxiliaries:
  - Cabin heater mode
  - Cabin air blowers
- o Wheel condition
- o Track:
  - Location on INCO line
  - Condition (including wet, dry, snow, etc.)
  - Railbed type
  - Alignment (tangent, curve, etc.)
  - Switches
  - Joints
  - Gauge
- o Wind
  - Speed
  - Direction
- o Location within vehicle
- o Noise level

4.1.2 Wayside

- o Engine speed
- o Engine acceleration position
- o Transmission mode

- o Vehicle speed
- o Vehicle load
- o Auxiliaries:
  - Cabin heater mode
  - Cabin air blowers
- o Wheel condition
- o Vehicle condition (modifications)
- o Track:
  - Location on INCO line
  - Condition (including wet, dry, snow, etc.)
  - Railbed type
  - Alignment (tangent, curve, etc.)
  - Switches
  - Joints
  - Gauge
- o Wind
  - Speed
  - Direction
- o Environment
- o Location relative to test vehicle
- o Noise level

4.2 VIBRATIONS

- o Vehicle speed
- o Vehicle load/weight distribution
- o Vehicle spring rate(s)
- o Damper characteristic(s)
- o Wheel diameter
- o Wheel condition
- o Vehicle condition (modifications)
- o Track:
  - Condition
  - Switches
  - Joints
- o Vertical wheel acceleration

4.3 RIDE QUALITY

- o Vehicle speed
- o Engine speed
- o Accelerator position
- o Vehicle weight (load)
- o Wheel diameter
- o Wheel conditions
- o Vehicle condition (modifications)
- o Spring rate(s)
- o Damper characteristics
- o Spring mounting (vibration reduction measures)
- o Location of measurement site within vehicle
- o Track:
  - Location on INCO line
  - Condition
  - Alignment
  - Switches
  - Joints
- o Ride Quality:
  - Vertical
  - Lateral

4.4 WHEEL/RAIL INTERFACE

4.4.1 Stability

- o Vehicle speed
- o Vehicle load
- o Vehicle movement (lateral and vertical)
- o Vehicle weight distribution
- o Spring rate(s)
- o Damper characteristic(s)
- o Track:
  - Location on INCO line
  - Condition (including wet, dry, snow, etc.)

- Alignment (tangent, curve, etc.)
- Gauge

o Lateral wheel acceleration

o Wheel flange/rail contact

4.4.2 Curving Behaviour

o Vehicle speed

o Vehicle load

o Vehicle weight distribution

o Vehicle movement

o Track:

- Location on INCO line
- Condition (including wet, dry, snow, etc.)
- Curves radius
- Gage

o Wheel flange/rail contact

4.4.3 Switching Behaviour

o Vehicle speed

o Vehicle load

o Vehicle weight distribution

o Vehicle movement

o Track:

- Location on INCO line
- Condition (including wet, dry, snow, etc)
- Switch Type (including direction)
- Gage

o Wheel flange/rail contact

4.5 FUEL CONSUMPTION

o Vehicle speed

o Vehicle plus payload weight

o Engine accessory loads

- o Auxiliary (cabin) heater operation
- o Ambient temperature
- o Wind:
  - Speed
  - Direction
- o Idling time
- o Snow clearance
- o Distance travelled
- o Vehicle movement
- o Fuel consumed

4.6 RELIABILITY AND WEAR

- o Wheel tread and flange profile (wear)
- o Wheel bearing end-play (wear and/or damage)
- o Vehicle speed
- o Vehicle weight (net)
- o Distance travelled
- o Bearing lubricant
- o Vehicle movement
- o Vehicle history
- o Periodic Inspection Results
  - Appearance
  - Play
  - Damage (if any)

4.7 RERAILING

- o Vehicle load
- o Vehicle weight distribution
- o Track bed type
- o Track bed condition
- o Degree of derailment
- o Rerailing equipment, e.g., jack type, hoist/slings

- o Manpower
- o Ambient conditions:
  - Wind
  - Snow
  - Rain
  - Temperature
- o Time taken to rerail
- o Location on INCO line
- o Vehicle history

4.8 TURNTABLE

- o Vehicle load
- o Vehicle weight distribution
- o Engine speed
- o Turntable mode (deploy, rotate, retract, lock)
- o Degree of rotation (position)
- o Time to deploy
- o Rotating speed
- o Time to retract
- o Total time to turn bus thru 180°
- o Method of alignment
- o Weather conditions

4.9 ENERGY

- o Battery:
  - Specific gravity
  - terminal voltage
  - temperature
  - current
- o Time
- o Electrical load:
  - Current
  - Terminal voltage
- o Accessory configuration

4.10 DRAW BAR

- o Test vehicle weight
- o Test vehicle speed
- o Test vehicle direction of travel
- o Test vehicle acceleration
- o Tow vehicle weight
- o Tow vehicle type
- o Tractive effort
- o Towing mode i.e., push or pull
- o Slack in draw bar

4.11 DEADMAN SWITCH

- o Vehicle speed
- o Vehicle operating mode
- o Vehicle load
- o Vehicle weight distribution
- o Deadman switch position (open/close)
- o Rail condition
- o Wheel condition
- o Time and distance to stop vehicle and complete cycle (reset)

4.12 EMERGENCY ENGINE SHUT-OFF SWITCH

- o Engine speed
- o Fuel rack position (accelerator position)
- o Vehicle speed
- o Transmission mode
- o Time

5.0 MEASUREMENT OF TEST VARIABLES

5.1 VEHICLE

5.1.1 Weight, Load and Weight Distribution

The fully fueled empty vehicle will be weigned by supporting it, at each of four prescribed points, on load cells. The output of each cell is entered in the log book. Weight distribution is obtained by calculation. Load is determined by similarly weighing the loaded venicle and subtracting the empty vehicle weight.

5.1.2 Speed

The vehicle speed will be read from the existing speedometer which will be calibrated by a method to be determined.

5.1.3 Distance Travelled

A revolution counter ("Hubodometer") will be attached to the hub of one of the front (undriven) wheels. The counter will increment for both clockwise and counterclockwise wheel rotation. The circumference of the wheel at the tape-line will be measured and entered in the log book. Distance travelled will be obtained by calculation.

5.1.4 Fuel Consumed

The quantity of replenishment fuel issued to the vehicle will be measured at the dispensing fuel pump and entered in the log book. The fuel tank will be "topped" before and again after testing.

Care will be taken to ensure that vehicle attitude is the same during both operations.

5.1.5 Vehicle Acceleration

Vehicle acceleration ("Ride Quality") will be measured by means of an accelerometer the conditioned output of which will be recorded on chart recorder. The accelerometer will be suitably mounted on a flat plate and located on the floor of the vehicle close to the centre, aligned in the direction of vehicle travel.

5.1.6 Wheels

5.1.6.1 Wheel Diameter

Wheel diameter will be measured by one of the following methods:

i) The wheel will be marked at the edge of the tread. The vehicle will be moved such that the wheel rotates one revolution. Distance moved will be measured using a tape measure and recorded in the log book. Diameter will be calculated and recorded.

ii) The circumference of the wheel at the tape line will be measured using a tape measure and recorded in the log book. Diameter will be calculated.

5.1.6.2 Wheel Condition

i) Swash and eccentricity will be measured by means of a dial gauge, while rotating the wheel. T.I.R. will be measured both for radial and axial deflections. T.I.R. will be noted in the log book.

ii) Tread and flange condition will be measured and recorded using the UTDC R&D Tread wear measuring instrument. All records so obtained will be annotated with the wheel position on the vehicle, together with the date and mileage.

5.1.6.3 Wheel Bearings

i) Bearings will be checked for "End play" by manually "wobbling" the unloaded wheel.

ii) Lubricant manufacturer, type and specification will be noted in the log book.

5.1.6.4 Wheel Accelerations

i) Vertical and lateral accelerations will be measured by recording on chart the conditioned output of suitably mounted (per Section 3.2) accelerometers.

ii) In the first instance lateral accelerations will be judged by suitably qualified TTL Test personnel using video monitor system. Only in the event that it is judged necessary will the axle in question be instrumented with an accelerometer, in which case the conditional output is to be recorded on chart.

5.1.7 Battery

i) Specific gravity of the electrolyte will be measured using a commercial quality automative hydrometer.

ii) Terminal voltage will be measured using a calibrated digital voltmeter.

iii) Electrolyte temperature will be measured using a commercial quality mercury or alcohol thermometer.

iv) Current will be measured using calibrated instrumentation as follows:

a) Direct measuring ammeter (DC) introduced into circuit, or

b) Suitable sensitive voltmeter in conjunction with shunt introduced into circuit.

v) Load will be calculated from ii) and iv) above.

5.1.8 Engine Speed

Engine speed will be measured, if practical, using a stroboscope or equivalent if available. In the event such equipment proves not available on-site, or for hire, engine speed will be estimated by experienced TTL personnel.

5.1.9 Auxiliaries

i) Operation of the cabin heater, where relevent, will be noted on test card and/or log book.

ii) Engine accessory load will be ascertained by method to be determined as necessary.

iii) Other tests later determined.

5.1.10 Engine Transmission Mode

It is anticipated that test personnel will be able to hear transmission shifting. This data is considered "nice to know" but non-essential.

5.1.11 Accelerator Position

Accelerator position will be observed and appropriately noted on test card.

5.1.12 Turntable

Turntable operation will be monitored visually, by direct observation if possible. In the unlikely event such direct observation is impractical, recourse to video (tape) system will be considered.

5.1.13 Deadman Switch Position (mode)

The position (mode) of the deadman switch will be ascertain by direct observation and noted appropriately.

5.1.14 Emergency Shut-Off

The mode of the Emergency Shut-Off control will be ascertained by direct observation and noted appropriately.

5.1.15 Direction of Travel

Will be observed and noted w.r.t. compass points and vehicle orientation, e.g., NW, forwards.

5.1.16 Suspension

Spring rates will be assumed to be as reported. Damper characteristics will be established, if practical, from manufacturer's published literature. Within the framework of this activity this data is considered "nice to know" but non-essential.

Vibration reduction measures in use, such as resilient material introduced into the suspension system, will be noted as appropriate.

5.2 TRACK

5.2.1 Condition

Track condition, wet, dry or snow etc. will be observed and duly noted.

5.2.2 Railbed

Type and condition will be observed and duly noted.

5.2.3 Alignment

Alignment will be ascertained where not critical by observation. Where requirement exists, reference will be made to survey drawings if possible. Only if essential and unavoidable will recourse be made to on the spot measurement and calculation.

5.2.4 Switches

Type of switch and direction of vehicle passage will be observed and duly noted.

5.2.5 Joints

Rail joints will be noted where pertinent.

5.2.6 Gauge

Gauge and/or flange clearance will be measured, where necessary, using tape or gauge rod. Dimensions will be duly noted.

5.3 AMBIENT CONDITIONS

Ambient temperature will be measured by means of a mercury thermometer in accordance with standard practice i.e., approx. 1.5 m above ground, shaded from direct sun, away from buildings etc.

Wind speed and direction will be estimated. Data will be duly noted and cross-referenced with data from the local airport meteorological office.

5.4 MISCELLANEOUS

5.4.1 Time

Time will be measured using wrist-watch or equivalent, or stopwatch as appropriate. Measured intervals will be noted.

5.4.2 Noise Level

Noise level will be measured using a hand-held calibrated and certified instrument, equipped with visual level indication. Noise levels will be noted on test card.

5.4.3 Ride Quality

Ride Quality will be measured using a calibrated certified industry standard instrument (British Rail Ride Meter MK II) the output from which will be recorded on chart.

In addition, the visual analog indicator will be observed and readings noted as appropriate.

5.4.4 Wheel Flange/Rail Contact

By observation both direct and by means of video camera(s) the output from which will be both recorded on magnetic video tape and monitored in real time using a video monitor. The equipment used will be capable of handling two channels of data similtaneously, and further, will be capable of recording "time" on the tape.

5.4.5 Rerailing

This essentially manual operation will be observed and observations noted.

5.4.6 Towing

Tow vehicle weight and tractive effort will be ascertained from vehicle operator or manufacturers specification.

Towing mode (push or pull) together with slack in the draw-bar/coupling assembly will be ascertained by direct observation and duly noted.

Force in the draw-bar and attaching hardware is not measured.

6.0 TEST PARAMETERS

6.1 NOISE

To meet the objective of measuring the contribution to noise level made by the vehicle, both on-board and wayside measurements will be made in the absence of external noises. These include external traffic and/or pedestrian sounds, machinery, reflections from buildings, etc. The objective must be to measure sound levels in an open, unobstructed area. Auxiliary generator for test equipment supply must not be running.

6.2 VIBRATIONS

The objectives of this test require that the vehicle be exercised fully: i.e., over the vehicle's operating range of speed, load, acceleration and braking. It is not required to pursue the limits of performance of the test vehicle where to do so contravenes either regulation or when imprudent.

6.3 RIDE QUALITY

The test instrument to be used measures, essentially, the ride quality of the track vehicle system. It follows, therefore, that track reasonably representative of "commercial standard" track be used.

6.4 WHEEL/RAIL INTERFACE

6.4.1 Stability

In keeping with the universally accepted understanding that, other things being equal, the speed at which a vehicle becomes

unstable is inversely related to the weight of the vehicle, this test will be carried out with the vehicle empty plus test equipment and test personnel.

6.4.2 Curving Behaviour

To be attempted in the tightest curve available consistent with Section 8.4. In the event of failure, progressively easier curves should be attempted until the curving limitation is found. Vehicle to be tested at full load and empty plus test equipment and test personnel.

6.4.3 Switching Behaviour

With fully loaded vehicle and with empty vehicle plus test equipment and test personnel.

6.5 FUEL CONSUMPTION

With fully loaded vehicle and with empty vehicle plus test equipment and test personnel.

6.6 RELIABILITY AND WEAR

The objective should be to run as much as practical at full rated load. It may be convenient to run considerable distances, for the purpose of other tests, at part-or no-load. This is acceptable provided that the load with which mileage is accummulated is recorded in every case.

6.7 RERAILING

Empty vehicle (Test equipment permitted.)

6.8 TURNTABLE SYSTEM

Empty vehicle (Test equipment permitted).

6.9 ENERGY

Engine OFF. Other TBD.

6.10 DRAW-BAR OPERATION

Fully loaded vehicle.

6.11 DEADMAN SWITCH

a) Fully loaded vehicle (evenly distributed)

b) Vehicle empty plus test equipment and test personnel.

6.12 EMERGENCY ENGINE AND POWER SHUT-OFF SWITCH

The parameters for this test will be determined following design of the shut-off system, but will probably include the requirement to test the shut-off switch for each case of auxiliary heater (cabin heater) running and not-running.

7.0 INSTRUMENTATION CONSIDERATIONS

7.1 WEIGHING INSTRUMENTATION

Due to the design of the vehicle and venicle axles, and to eliminate the costly need for careful positioning of the vehicle, a weighing capability with four simultaneously deployed load cells is required. The "Revere 4-channel Aircraft Weighing Kit" with a capacity of 100,000 pounds is suitable. Any similar 4-channel system with a capacity of not less than 10,000 pounds per cell is acceptable.

7.2 SPEEDOMETER

At least two methods of speedometer calibration are likely to be acceptable.

a) Adjustment of existing electronic circuitry.

b) Provide new scale (meter card) behind speedometer needle.

In either case, the accuracy of the instrument should be established by timing the vehicle over a measured distance at not less than three different speeds. The range of speeds over which accuracy should be checked should be wide enough to allow identification of any significant non-linearity.

7.3 DISTANCE MEASUREMENT

The device specified in Section 5.1.3, by its very design, tends to work properly or not at all. A functional check of this device before and again after the test is deemed sufficient check.

In the event the wheel diameter is changed significantly during the test e.g., wheel(s) reground, this is to be recorded in the log-book together with the necessary revision to the appropriate conversion factor.

7.4 FUEL MEASUREMENT

It is assumed initially that the pumps used to dispense fuel to the test vehicle satisfy necessary government inspection standards as regards accuracy of measurement of fuel dispensed, in which case no further check is required. In the event this is not the case, a check will be devised.

7.5 VEHICLE ACCELEROMETER

The accelerometer is to respond to accelerations in both positive and negative directions. Zero "G" is to be noted on the chart, while full scale deflection of the recorder pen is not to exceed 0.5 G.

It is anticipated that the chart recorder to be used has an input impedence of 100 K ohm. This dictates that the driving unit, in this case the accelerometer, must have an output impedence of less than 1 K ohm, which in turn implies the necessity to introduce a suitable signal conditioner between the accelerometer and the recorder. It is proposed to use a "TERRATECHNOLOGY SA 102A" accelerometer, with output impedence 100 ohm, in which case no further conditioning is necessary.

This device requires excitation at ±10 Vdc. A suitable regulated supply must be provided.

7.6 TAPE MEASURE

"Off-the-shelf" commercially available tape measure is deemed acceptable.

7.7 DIAL GAUGE

Commercially acceptable standards of accuracy are deemed acceptable.

7.8 WHEEL ACCELEROMETER

Accelerometer and signal conditioners calibrated together by UTDC Instrumentation department, set up and installed in accordance with furnished transfer function data will be used. 6 dB @ not more than 50 Hz. 25 Hz roll-off preferred.

7.9 HYDROMETER

Commercial quality is satisfactory.

7.10 TEMPERATURE

Commercial quality is satisfactory.

7.11 VOLTAGE

Measurement instrument calibrated by UTDC Instrumentation Department.

7.12 CURRENT

Measurement devices calibrated by UTDC Instrumentation Department.

7.13 STROBOSCOPE

Commercial Standard of accuracy is acceptable, i.e., reference calibration to commercial 60 Hz line frequency, or harmonic thereof.

7.14 STOPWATCH/WATCH

Any measurements made of time intervals of less than 60 seconds should be made using a device with combined accuracy and resolution and reading error of less than ±one second.

7.15 NOISE METER

Preferably completely self contained to allow portability, the instrument must be certified and capable of measuring sound levels weighed in accordance with the internationally accepted "A" scale of industrial sound pressure levels. The sensing device, i.e., the microphone must be equally sensitive to sound originating from a constant equidistant source located at any point radially displaced up to 135° from the microphone axis.

7.16 RIDE QUALITY

Ride quality will be measured using a commercially accepted standard meter (British Rail) calibrated by UTDC Instrumentation Department.

7.17 CHART RECORDER

Any chart recorder used must have a half-scale frequency response flat with 1 dB to 30 Hz, and not more than 6 dB attenuation at 60 Hz.

8.0 TEST PLAN

8.1 NOISE

The venicle will be divided into five areas of on-board measurements. A noise survey will be taken under noise testing conditions (ref. section 4.1) to determine positions of worst case samples in each of the areas. All sample data will then be gathered from these positions. See Figure 1.

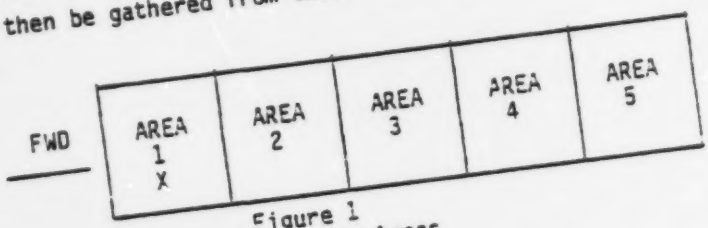

Figure 1
On-Board Noise Areas

Wayside measurements will be taken from a position approximately 15 m (50 ft) from and 1.5 m (5 ft) above the running rail at a portion of track to be chosen for its suitability for noise testing. (Reference section 4.1)

8.1.1 On-Board Noise

The following sequence will be followed for noise testing on-board:

a) all non-essential auxiliaries will be shut down;

b) vehicle will cruise through test portion of track at 50 km/h (30 mph) in the forward direction;

c) peak dB(A) reading will be taken from a 10 sec sampled at each of the five positions identified by the survey. This reading will be recorded;

d) vehicle will be turned 130°;

e) repeat a), b) and c) in opposite direction;

f) repeat a), b), c) and d) until three acceptable samples are taken;

g) repeat a), b), c), d), e) and f) at 65 km/h (40 mph); and

h) repeat a), b), c), d), e) and f) at 80 km/h (50 mph) or other predetermined maximum safe operational speed.

8.1.2 Wayside Noise

The following sequence will be followed for wayside noise testing:

a) all non-essential auxiliaries will be shut down;

b) vehicle will cruise past sampling point at 50 km/h (30 mph);

c) peak dB(A) will be read and recorded;

d) vehicle will be turned 180°;

e) repeat a), b), c) and d) in opposite direction; and

f) repeat a), b), c), d) and e) at 80 km/h (50 mph) or other predetermined maximum safe operational speed.

8.2 VIBRATION

A test section of track will be chosen in accordance with section 3.2. An accelerometer will be mounted on each of the right hand front and rear axle bearing housings to measure vertical accelerations and the output attached to a recorder.

The vehicle will be run through the test track section at 50 km/h (30 mph) and recordings taken three times. This will be repeated at the maximum predetermined operational speed. These recordings will be taken in a loaded and unloaded configuration.

8.3 RIDE QUALITY

A test portion of track will be chosen in accordance with 3.3. Testing for ride quality will take place in the following sequence:

a) vehicle will enter test zone with BRRM running on lateral and connected to recorder running with paper speed at 10 mm/sec.;

b) vehicle speed throughout test to be maximum safe operating speed;

c) event marker will be tripped at predetermined points along test zone to establish vehicle position;

d) average and peak readings will be taken from strip chart;

e) repeat a), b), c) and d) for a total of three samples;

f) repeat a), b), c) d) and e) except with BRRM running on vertical;

g) repeat a), b), c), d), e), and f) for all three locations.

8.4 WHEEL/RAIL INTERFACE

8.4.1 Stability

The following sequence will be used to determine stability:

a) a test portion of the track will be chosen (same portion as ride quality test);

b) vehicle will be run through the portion at 50 km/h (30 mph);

c) wheel/rail interface will be monitored to determine any instabilities (hunting, unstable oscillations, etc.);

d) repeat a), b) and c) at 60 km/h (36 mph);

e) repeat a), b) and c) at 70 km/h (42 mph); and

f) repeat a), b) and c) at 80 km/h (50 mph) if possible. If not possible, repeat at maximum safe speed.

8.4.2 Curving Behaviour

The following sequence will be used to determine curving ability:

a) a representative minimum radius curve that would be used on CN track and a minimum radius curve on INCO track will be used as the test curves for curving performance testing;

b) the vehicle will be run through each curve at different speeds while observing the tendency of the wheels to climb out; and

c) from these observations, a maximum safe curving speed will be determined.

8.4.3 Switching Behaviour

The following sequence will be used to determine switching behaviour:

a) three representative switches will be chosen:

b) the vehicle will be operated through these switches at varying speeds while observing the tendency of the wheels to derail or follow the wrong alignment;

c) switches and wheels will be examined for damage after the test; and

d) from these observations, a safe maximum switching speed will be determined.

8.5 FUEL CONSUMPTION

Fuel consumption will be determined by:

a) noting vehicle configuration especially weight distribution;

b) filling the fuel tank to the top of the filler neck and recording hubodometer reading;

c) operating vehicle for two days;

d) reconfigure vehicle, if necessary, to a) above; and

e) filling the fuel tank to top of the filler neck and recording amount of fuel used and hubodometer reading.

8.6 RELIABILITY AND WEAR

Wheel wear and vehicle reliability will be determined by running the vehicle, as much as practical, at full rated load. Total mileage accumulation under full and partly rated load will be no less than 3,000 km.

8.7 RE-RAILING

Several procedures will be demonstrated on the INCO line to re-rail the railbus. The vehicle will be purposely de-railed using the turntable and various procedures demonstrated to determine the method and equipment most appropriate. The vehicle will be unloaded during the tests.

8.8 TURNTABLE SYSTEM

The operation of the turntable cycle will be to verify its reliability and design. Routine checks of the turntable will be noted during the test period and observations made during adverse winter conditions.

8.9 ENERGY

The ability of the vehicle to sustain a comfortable interior environment during emergency situations (engine off) will be demonstrated. The heating capacity and battery life expectancy will be determined with only auxiliary heating and lighting in operation.

Other tests and results will be discussed in the Final Report.

8.10 DRAWBAR OPERATION

The capability of the drawbar mechanism when connected to aid in the railbus rescue will be demonstrated. Operational procedures and vehicle type will be noted, as well as its ability to negotiate various curves while operating in emergency mode.

8.11 DEADMAN SWITCH

Due to lack of specific information on the design of the system yet to be installed, details of its operation and procedures for use will be determined on site and discussed in the Final Report (Testing).

8.12 EMERGENCY ENGINE AND POWER SHUT-OFF SWITCH

As with the deadman switch, the operation and procedures for its use will be determined during testing and details will be included in the Final Report.

No. _____

TEST CARD COVER

DATE: _____ START TIME: _____ FINISH TIME: _____

TEMPERATURE: _____ RAIL CONDITION: _____

TEST TITLE: _____

PERSONNEL: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

HUBODOMETER START: _____ FINISH: _____

TOTAL: _____ WHEEL DIA: _____

COMMENTS

ON-BOARD NOISE

VEHICLE SPEED: _____

AVERAGE ENGINE RPM: _____

TEST SECTION BETWEEN MI _____ AND MI _____

FIRST DIRECTION	OPPOSITE DIRECTION
AREA 1	AREA 1
AREA 2	AREA 2
AREA 3	AREA 3
AREA 4	AREA 4
AREA 5	AREA 5

WAYSIDE NOISE

VEHICLE SPEEDS: 1)_____ 2)_____ 3)_____

TEST SECTION MI: _____

	FIRST DIRECTION	OPPOSITE DIRECTION
SPEED:		
READINGS:		
SPEED:		
READINGS:		
SPEED:		
READINGS:		

COMMENTS

VIBRATION

CHART NO.: _____

VEHICLE SPEEDS: 1) _____ 2) _____

VEHICLE LOAD: _____

SPEED: _____

READING: _____

_____

_____

SPEED: _____

READING: _____

_____

_____

COMMENTS

RIDE QUALITY

LATERAL

AVERAGE	PEAK

VERTICAL

AVERAGE	PEAK

COMMENTS

STABILITY

TEST PORTION MI _____ TO MI _____

VIDEO TAPE NO.: _____ FROM _____ TO _____

OBSERVATIONS

CURVING PERFORMANCE

TEST CURVE LOCATIONS:

_____

_____

VIDEO TAPE NO.: _____ FROM: _____ TO: _____

OBSERVATIONS

TEST SWITCH LOCATIONS:

1) _____

2) _____

3) _____

VIDEO TAPE NO.: _____ FROM: _____ TO: _____

OBSERVATIONS

FUEL CONSUMPTION

FUEL FILL DATE: _____ TIME: _____

HUBODOMETER: _____

_____

FUEL FILL AMOUNT: _____

DATE: _____ TIME: _____

HUBODOMETER: _____

COMMENTS